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ABSTRACT

Communications satellites transmit live interactive television broadcasts from a host site classroom to small and geographically isolated rural high schools. Using the research on effective teaching practices, this study examined the effectiveness of instruction delivered by satellite. Researchers observed 15 hours of three courses (Computer Science I, Art History I, and Sociology I) on the TI-IN Network. They calculated the frequency of the following teaching techniques using a content analysis design: (1) instructor initiated interaction; (2) student initiated interaction; (3) wait time; (4) level of questioning; (5) advance organizers; (6) statements of expectations for students; (7) review; (8) praise; and (9) corrective feedback. Researchers found that the instruction was interactive, students and teachers were talking back and forth to each other via the medium. The three observed teachers asked a sufficient number of low- and high-level questions with appropriate teacher wait time to permit students an opportunity to process information. They used advanced organizers, review, praise, and corrective feedback. Teachers stated their expectations for the students. The teaching behaviors occurred to the same extent that they occur in a traditional classroom. Further research should focus on the effectiveness of programs on other satellite networks. This paper contains 20 references and one table. (KS)



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# TEACHER EFFECTIVENESS VIA INTERACTIVE SATELLITE: PRELIMINARY FINDINGS FROM OBSERVATION OF THREE TEACHERS OVER THE TI-IN INTERACTIVE SATELLITE NETWORK

A Paper Presented at the 80th Annual Conference of the
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by

Bruce O. Barker
Assistant Professor of Education

Kenneth R. Patrick
Research Assistant

College of Education
Texas Tech University
Lubbock, Texas 79409

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

# TEACHER EFFECTIVENESS VIA INTERACTIVE SATELLITE: PRELIMINARY FINDINGS FROM OBSERVATION OF THREE TEACHERS OVER THE TI-IN INTERACTIVE SATELLITE NETWORK

## Introduction

For years administrators in small and geographically isolated rural high schools have struggled with the problem of providing a full range of course offerings for their students. Unfortunately, there are several factors working against the small school. Low student enrollment, minimal demand for specialized courses, geographical isolation and a shortage of qualified teachers are a few of the problems that must be overcome. Until recently, solutions to these problems were limited to strategies such as pairing agreements, travelling teachers, correspondence study, or school district consolidation (Barker, 1987a).

Today, with over 100 communications satellites in service around the globe, educators are taking advantage of these orbiting relays to beam high quality video and audio signals to distant classrooms through satellite television. Televised classes are nothing new. What is new, however, is live, two-way communication make possible by linking satellite technology with regular telephone service. Live TV broadcasts are beamed from the host site classroom via an up-link dish to the orbiting satellite some 22,000 miles above the equator. The signal is then beamed back to down-link dishes at receive site locations.

Satellite technology, in this configuration, permits one-way transmission of voice, data, and full-motion video. Audio talk-back by students at receive site locations is over regular telephone lines, thereby making the instruction interactive. By picking up a telephone, students at subscribing schools can call in questions on a toll-free line and hear their instructors' answers on the air. The technology is also capable of electronic copy distribution to create hard copy handouts, exams,

and course administration materials sent via satellite directly to the receiving schools. Students can both see and hear their instructor over the classroom television, but are not able to see other students located at different sites. The teacher, though unable to see students, is able to hear and respond to questions and comments whenever students call in on the telephone line.

The same technology that transmits the instructor's voice and image to the student can also be used to simultaneously transmit the student's voice and image back to the instructor. This type of full-motion, two-way interaction is rarely utilized at present, however, due to the expense.

Growing interest in the concept of interactive satellite instruction is being expressed by state and national education leaders and education policy makers in the United States. Congressional passage of $19 million funding for the Star Schools program is one recent example (Federal Register, 1988). Legislative approval to establish statewide satellite instructional systems in North Carolina, Kentucky, and Missouri are other examples (Barker, Frisbie, and Patrick, in press).

Four producers of high school credit coursework are presently offering classes to subscribing high school in the United States. These include: (1) Oklahoma State University's Arts and Sciences Teleconferencing Service; (2) SCI-STAR satellite program in Avon, Connecticut; (3) Eastern Washington University's Telecommunications Project; and (4) the TI-IN Network broadcasting from San Antonio, Texas (Barker, 1987c).

The largest and fastest growing producer of satellite teaching to schools is the TI-IN Network. At the time of this writing, TI-IN was offering 100 hours of live programming each week from its Texas studios to 524 sites in over 26 states (Babic, 1988). Offerings include over 20 different high school courses plus over 400 hours of inservice training and staff development, selected college credit courses, student

enrichment programming, student remediation courses, test reviews for both teachers and students, and community interest programs.

As interest in teaching remote and/or geographically isolated students via satellite technology -- and other forms of telecommunications -- continue, questions related to the quality of instruction delivered will naturally be posed. Does satellite delivery of high school instruction which provides one-way video, two-way audio interaction with all of its advanced technological delivery resources, effectively provide participating students with a quality learning experience? The purpose of this paper is to present original research findings from the field which are intended to help answer this question.

**Specific Research Questions**

Prior to designing and conducting our study to look at the effectiveness of satellite delivered instruction, we first went to the literature to review some of the findings on effective teaching practices. Inasmuch as interactive satellite teaching seems to perpetuate the existing and familiar model of teacher-present/student-recite pattern of traditional classroom instruction, we felt it appropriate to compare instruction via satellite with the traditional model. Over the past 20 years there have been thousands of studies made on effective schools and effective classrooms. In the decade between 1969 and 1979 alone, more than 2700 findings were reported in the literature (Walberg, Schiller, & Haertel, 1979). Due to the novelty of the electronic classroom, however, very little of the current research deals with the newer technology.

Numerous factors became evident as we probed the literature on effective schools. These included school beliefs, school climate, the role of the principal, quantity of schooling, preschool experiences, safe environment in the schools, class size, and a host of others (Behling, Jr., 1986). Not surprisingly, a large body of

research indicated that perhaps the key factor in an effective classroom is the teacher. A five-year study conducted in 12 London schools concluded that teachers and administrators control the difference between effective and ineffective schools (Rutter, Manghan, Mortimire, Ouston and Smith, 1979).

Among specific teacher behaviors noted in the research were providing effective praise (Brophy, 1981), allowing sufficient wait time during questioning, posing suitable questions at the student's cognitive level, use of advance organizers, and frequent content reviews (Cruickshank, 1986). Because the teacher is such an important element in the educational process, whether in a traditional setting or in a distance education setting, we felt that one way to help determine the effectiveness of satellite delivered instruction was to document the characteristics of instructors teaching via a satellite system.

Finding answers to the following questions would indicate how often selected satellite TV instructors utilized proven, effective teaching techniques in a given time period. Such information would also be a valuable addition to the scant body of research on this new approach to teaching.

1. How often does the instructor initiate interaction with each student?
2. How often do the students initiate interaction with the instructor?
3. How much wait time does the instructor give a student responding to a question?
4. How often does the instructor ask questions that correspond to lower levels of Bloom's Taxonomy of Thinking Skills?
5. How often does the instructor ask questions that correspond to higher levels of Bloom's Taxonomy of Thinking Skills?
6. How often does the instructor use advance organizers?
7. How often does the instructor specify student expectations?

8. How much time does the instructor spend in reviewing previous lessons?

9. How often does the instructor praise student answers?

10. How often does the instructor provide corrective feedback?

## Procedures

The TI-IN Network was chosen as the interactive satellite system to study because it is the largest and fastest growing interactive satellite instruction network in the United States. TI-IN high school classes are broadcast five days each week, 175 broadcasts per school year. Each daily class broadcast is 55 minutes. Fifteen hours of selected TI-IN instruction were observed and videotaped on television during late February through early March 1988. High school classes observed were Computer Science I, Art History I, and Sociology I. Five periods of instruction were observed for each of these three classes. These courses were selected because they were either in the teaching fields in which one of the researchers was certified to teach or in which he had received significant college training.

All teacher and student dialogue observed during the study period was transcribed into a written narrative (transcript) and a machine readable format using the Microsoft Word word processing program. The transcripts included five hours of actual classroom instruction conducted by teachers in each of the three classes noted above. Computer programs were developed and written by the researchers to (1) separate the teacher dialogue from the student dialogue, and (2) to count the number of words in various word groupings.

Selected characteristics of effective teaching practices were identified from the literature. A content analysis design developed by the researchers was used to determine the frequency of predetermined effective teaching practices.

## Findings

Research from the literature indicates that the use of advance organizers

(Luiten, Ames, and Ackerson, 1980) and frequent reviews (Good and Grouws, 1979) contribute positively to student achievement. To measure the extent of use of advanced organizers and reviews, transcripts for each of the three classes were inspected and relevant passages were flagged. The flagged passages were they processed by the computer and the total number of words in each passage calculated. For this study, "advance organizer" was defined as any part of the teacher dialogue that indicated to the students what the instructor intended to do during the immediate class period or any future class period. Most of the advance organizer statements contained key phrases such as, "Today we will...", or, "Tomorrow we are going to...", or, "The important concept to understand is ...", etc. These may or may not have been accompanied by a visual aid. "Review" was defined as any part of the teacher dialogue that directed the students' attention to previous classwork or discussions. Most of the review statements contained key phrases such as, "Remember back...", or, "Yesterday we...", etc. Analysis of videotapes and transcripts showed that all three instructors devoted class time to advance organizers and reviews. Advanced organizers were employed and reviews conducted in each of the three classes each day. During the five day observation period, 7.3 percent of the Art History teacher's instructional time was devoted to employing the technique of an advanced organizer and 9.2 percent was devoted to content review. In Computer Science, the percentages were 5.0 and 6.2 respectively, and in Sociology 11.3 and 23.7.

In addition to the use of advance organizers and reviews, research from the literature indicates that communicating student expectations positively affects student performance (Cooper, 1979). Inspection of the transcripts revealed that all three instructors informed their students about what was expected on a daily basis. Teacher statements of expectations included comments such as "Your assignment

today is ..." or "Today, I want you to ..." or "I want you to call in now and discuss ..." etc. Over the five day observation period, 35 statements of student expectations were noted from the Art History teacher. These ranged from a low of three statements of expectation on two separate days to a high of 13 on one day. The mean number of statements each day were seven. In Computer Science the total was 52 statements with a range of 4 to 15 and a mean of 10. For Sociology the total was 62 statements with a range of 2 to 20 and a mean of 12. It should be noted in Sociology, that on the day when only two statements of expectation were made, a quest lecturer had been invited to class who took up 81.4 percent of the instructional time.

One of the more attractive features of an interactive instructional system such as TI-IN is the potential for real-time exchanges between the instructor and the students. One question that was explored in the study was, "What percentage of the dialogue was carried out by the instructor, and what percentage was carried out by the students?" In seeking an answer to this question, the computer was used to separate the transcripts into two groups - teacher dialogue and student dialogue. Next, the computer tallied the words in each group. This method revealed that overall about 90 percent of the dialogue in the three classes was carried out by the individual teachers and the remaining 10 percent was carried out by the students. Specific breakdowns on teacher verbalization versus student verbalization were as follows: Art History 92.9 percent teacher talk versus 7.1 percent student talk; Computer Science, 89.3 percent and 10.7 percent; and Sociology, 91.7 percent and 8.3 percent.

Our interest in teacher/student interaction focused on the nature of these teacher/student exchanges -- that is how often did the instructors initiate interaction with the students and how often did the students initiate interaction

with the instructors. Determination of these two measures required direct observation of the transcripts. For purposes of the study, an "interaction" was defined as any verbal exchange, however lengthy, between the instructor and a student. The exchange might involve only one statement from each of the participants, or a series of statements. A new interaction was determined to occur whenever another student was either addressed by the instructor, or was responsible for addressing the instructor. Based on this criteria, both instructors and students were likely to initiate interactions. In Art History the total number of teacher initiated interactions in the five days was 38. The range was from zero to 14 for a mean of 7.6. Student initiated interactions totaled 29 with a range of one to 9 and a mean of 5.8. In Computer Science the total teacher initiated interactions was 57 and student initiated was 34. The ranges were respectively zero to 22 and 4 to 14, and means were 11.4 and 6.8. In Sociology, teacher initiated interactions totaled 65 whereas student interactions were only 11. The ranges were three to 36 and zero to seven, and means were 13 and 2.2.

As in traditional classrooms, much of the teacher/student interaction involved question and answer episodes. To quantify that type of activity, Bloom's Taxonomy of Thinking Processes was utilized. Each question in the transcripts was analyzed and assigned to one to two categories - "High Bloom" or "Low Bloom". The former category included levels three through six of the well known taxonomy (application, analysis, synthesis and evaluation). The latter category included levels one and two (knowledge and comprehension). Rhetorical questions and questions such as "Are you with me?", "Do you see what I'm saying?", and, "Right?" were not included in either group. The two categories (High Bloom and Low Bloom) were tallied. This revealed a large number of questions in each group. This was construed to be beneficial to the students because research indicates that high levels of low-order

questions promote achievement (Brophy and Everston, 1976), and that students who are asked more high-order questions achieve more (Redfield and Rousseau, 1981). In addition, Tobin and Capie (1982) found that student attention was enhanced when the questions, among other things, represented a variety of cognitive levels. In Art History the total number of Low Bloom questions asked in the five days by the teacher was 19 and 15 High Bloom questions were asked. The range for Low Bloom questions ran from zero for two days to eight and for High Bloom was zero (one day) to six. The means were respectively 3.8 and 3.0. In Computer Science there were 70 Low Bloom questions and 31 High Bloom questions. The ranges were zero (two days) to 28 and zero (two days) to 16. The means were 14 and 6.2. In Sociology the totals were 124 Low Bloom and 143 High Bloom with ranges of zero (one day -- guest lecture) to 44 and zero (one day -- guest lecture). The means were 24.8 and 28.6.

Directly related to the questioning episodes was the concept of "wait-time". When students did not immediately answer a teacher initiated question, our interest was in how long the instructors would wait for a response before either answering their own question, restating the questions, or providing cues to students. Tobin and Capie (1982) concluded that a three second pause was optimal on the part of the teacher. Rowe (1974) determined that student performance was enhanced when teachers extended a mean wait-time from three seconds to five seconds. Measurement of teacher wait-time and student-process or think time was conducted only during the class times that a student or group of students were on-line via the telephone with their instructor. To quantify the length of the wait-time/process-time periods, we had to deal with two conditions: (1) either students responded to the question or (2) students did not respond to the question and the teacher intervened. In the first situation, the number of seconds between the completion of

the question and the beginning of the answer was noted. This was labeled as the average think time before student response. Between the three classes, the average think time before student response was just under two seconds (1.9). The longest student process time was in Computer Science, 2.6 seconds on the average. Art History and Computer Science were almost the same, 1.5 and 1.6 seconds on the average, respectively. In the second situation, the number of seconds between the completion of the question and the instructor's subsequent intervention was noted. This became the average teacher wait-time. Each of the three teachers fell within proper norms for wait-time. The Art History teacher waited on the average 3.8 seconds; Computer Science, 5.3 seconds, and Sociology, 4,8 seconds.

Once a question had been responded to, teachers had the option to either praise correct answers or to provide corrective feedback to incorrect or marginal answers. Because students respond positively to praise (Brophy, 1981), and errors should not go uncorrected (Rosenshine, 1983), we tallied the occurrences of teacher initiated praise and corrective feedback in the transcripts. "Praise" was defined as the teachers' positive responses to student answers that go beyond mere affirmation or positive feedback. Merely repeating an answer, saying "right", "yes", or "OK" did not count as praise. Remarks such as "Good!', "Very good!", "Fine!", or "I like your answer!", etc. counted as praise (Brophy, 1981). "Corrective feedback" was defined as any statement or series of statements that directed the student toward a more proper response. During the observation period, 40 instances of praise were noted for the Art History teacher. This ranged from zero (one day) to 20 for a mean of eight. In Computer Science the total was 16 instances of praise. The range was from zero (two days) to 10 for a mean of only 3.2. In Sociology the total was 29 with a range of zero (one day) to 11 and a mean of 5.8. Instances of corrective feedback by teachers was noted as follows: Art History, 12, range of zero (three

days) to 11, mean of 2.4; Computer Science, 19, range of one to seven, mean of 3.8; and Sociology, 14, range of zero (two days) to 7, mean of 2,8.

**Observations and Conclusions**

The purpose of this study was to collect and analyze data that could be used to help answer the question, "Does satellite delivery of high school instruction which promotes one-way video, two-way audio interaction effectively provide students with a quality learning experience?" It should be noted that the findings reported herein are preliminary. A more thorough and complete analysis of data collected in this study has yet to be conducted. Additional information from the researchers will be forthcoming in journal articles submitted for publication. It should also be noted that this study was limited to three satellite TV teachers on the TI-IN Network over a five day period. Additional studies observing instruction of other teachers over TI-IN and of instructors on the Oklahoma State University network, the Eastern Washington University network, and the SCI-STAR network would provide useful comparative data.

Based on preliminary findings and in consideration of the parameters of this study, we conclude that quality instruction can and does occur via interactive satellite TV teaching. Specifically, we would like to note:

1. Each of the TI-IN teachers observed appeared to be cognizant of the effective teaching characteristics under investigation and to varying degrees were practicing them. Whether or not this was intentional on the part of the teachers or purposely planned and requested by TI-IN administrators is unknown. The important thing is that the instruction was indeed interactive -- students and teachers were in fact talking back and forth to each other via the medium. In essence, the major aspects of a traditional classroom were being employed albeit via long distance. A sufficient number of low and higher level questions were being asked with appropriate teacher wait-time to permit students an opportunity to process information, student needs and interests were being attended, student praise was being extended, corrective feedback was being given, and student initiated interaction was occurring.

2. The three teachers appeared to have good rapport with their students. Each of them displayed a genuine interest in their students' affairs - not

only with classroom matters, but with other matters as well such a sports activities between schools, recreational activities in the local community, etc. Two of the teachers were usually able to recognize their students' voices and frequently called them by name. This projected a personalizing touch.

3. Each of the teachers were willing to model some of the behaviors that they were trying to teach. For example, the Computer Science teacher would enter programs from scratch along with the students. Any mistakes that he made would be corrected in plain view of the students. This allowed students to see that computer programs rarely run properly the first time, even when entered by a professional. It also was a good demonstration of various programming techniques designed to get the "bugs" out of a program. Likewise, the Art History teacher spent class time trying to redo a detail in one of her own paintings that she was not satisfied with. Like the computer teacher, the art teacher was willing to display some of her own work that was not up to standard and attempt to correct it. Similarly, the Sociology teacher, at one point, had a group of kindergarten students as guests in her class. She was addressing the topic of learned and inherited sex traits in children. Her students were expected to interview the kindergartners in an attempt to discover the boys' and girls' interests. Before the students asked their questions, though, the teacher asked a few sample questions of her own in order to demonstrate what was expected.

4. In general, the teachers seemed to make good use of their delivery medium. Rather than being just a "talking face" on a TV screen, they made use of numerous visual aids, such as art works, props, written materials, and purposely tried to "reach out" to students. During the period of observation, several guest speakers were present for varying lengths of time. On the other hand, the nature of the medium makes it easy for students to "hide" from the teacher. Two of the teachers observed were good at calling on specific students by name to call in and contribute to the class. For example, after calling on a specific student at a specific site and exchanging questions and answers, one teacher consistently called on another student at the same site while the phone connection was still made. Later, the same teacher would specify and encourage other sites to call in. This type of "forced interaction" made it more difficult for the students to avoid taking part in the class. The third teacher, however, did not call on specific students. She made several requests for students to call in, but it was always in the general sense. For instance "Ya'll be sure and call in now. I need your help."

5. The medium makes it difficult for the teacher to determine whether or not the students are able to follow the teacher's verbal pace or are fully responding to the teacher. Although students can see the TV teacher, the teacher is not able to see the students. This severely limits teacher sensitivity to student non-verbal cues or behavior. Two of the instructors used a consistent, moderate pace that was easy to follow. The third instructor, however, talked at a considerably faster pace and was difficult to follow.

Interest in satellite delivery of instruction is expected to grow. As it does, producers of interactive satellite programs can expect close scrutiny from educational researchers, administrators, and policy makers as to program quality and effectiveness. The novelty of course delivery via satellite has grown so rapidly in the last three years that few questions relative to program quality or student performance have been asked. That position is changing, and rightly so. It is both inappropriate and dangerous to fully embrace or accept a new approach without thorough evaluation.

Not only is continued research needed to study the effectiveness of satellite delivery as a viable medium, we also need well designed studies that compare one program producer with another. For example the TI-IN Network broadcasts their high school courses five days each week and the S.T.E.P. program, emanating from Washington state broadcasts high school courses four days each week. By comparison, the Arts and Science Teleconferencing Service (ASTS) at Oklahoma State University broadcasts high school courses only two or three days weekly (depending on the class) and the SCI-STAR series in Connecticut only one day each week. Class size between producers also varies. Whereas TI-IN and S.T.E.P. limit high school class size to around 200 students, after which a new section would be created, ASTS in Oklahoma has no apparent limit. ASTS, for example, offers one German language class which has over 1000 students. In one fashion or another, many educators have asked, "How interactive can a teacher be with 1000 students, especially when broadcasts are only two days per week?" Extent of course offerings also varies. At the close of the 1987-88 school year, TI-IN offered over 20 high school classes, ASTS offered five, S.T.E.P. offered four, and SCI-STAR offered less than five.

Satellite technology is capable of reaching a large number of students spread

over an extensive geographical area. Educators and other school officials who are interested in purchasing satellite reception equipment for their school and subscribing to an instructional network need to be aware of differences between vendors. Factors to consider include cost, maintenance, upgrading of equipment, extent of course offerings, limitations on class size, frequency of instructional broadcasts, quality of instruction provided by the teaching staff, skill of the instructional staff to "force interaction" with students, etc. It is also important to know whether or not students at all receive site locations are able to telephone their instructor during the broadcast or just designated classes which are "on-line." Programs which permit only selected on-line classes to call in can hardly pretend to be interactive when a majority of their students are simply watching a one-way TV instructional program that does not allow them to call-in to ask questions or make comments. A related factor is whether or not students at one receive site location would be able to be on-line with students at other receive site locations at the same time, thereby enabling not only teacher/student interaction but also student/student interaction. School administrators thinking of subscribing to a satellite network would be advised to contact program producers and seriously consider these factors prior to deciding which network to join. Furthermore, educational researchers might consider some of these factors as research topics worthy of consideration.

TABLE 1.

SUMMARY OF EFFECTIVE TEACHER BEHAVIORS OBSERVED OF 3 TI-IN TEACHERS DURING A 5 DAY PERIOD, SPRING 1988. REPORTED BY FREQUENCY.

| CLASS | TEACHER INITIATED INTERACTION | STUDENT INITIATED INTERACTION | LOW BLOOM QUESTION | HIGH BLOOM QUESTION | TEACHER STATEMENTS OF CORRECTIVE FEEDBACK | TEACHER STATEMENTS OF STUDENT EXPECTATIONS | EXPRESSIONS OF TEACHER PRAISE |
|---|---|---|---|---|---|---|---|
| Art History | 38 | 29 | 19 | 15 | 12 | 35 | 40 |
| Computer Science | 57 | 34 | 70 | 31 | 19 | 52 | 16 |
| Sociology | 65 | 11 | 124 | 143 | 14 | 62 | 29 |

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